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CAPTURING TACIT KNOWLEDGE FOR SPACECRAFT OPERATIONS IN ESOC

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ABSTRACT

The paper's focus is on the methodology developed in ESOC for the process of experts knowledge capture. The papers first objective is to illustrate the different techniques used for knowledge capture, emphasising the challenges posed by some of these techniques, such as: capturing key content in a limited time, conveying the value of the content, determining the appropriate role for video recording the process, determining what is the most valuable information to be shared, making the information available to the largest number of potential users, determining the extent and frequency of the interviews, encouraging the review of the draft captured materials. The papers second objective is to describe the steps which have been identified for the knowledge capture process: setting expectations and communication rules, structuring and conducting the interviews, preparing the list of questions to encourage the sharing of the tacit knowledge and reviewing the recorded material. Different approaches for the capture of tacit knowledge are investigated as this type of knowledge is the result of human experience and intuition and therefore adaptations of capturing techniques are needed to cope with the different cultural backgrounds of individuals. The different solutions are then negotiated with each interviewee concerning the objectives, the availability, the number of sessions to be performed, the nature and depth of materials to be prepared for further distribution, locations of interviews and many more considerations.

1. INTRODUCTION

ESOC, the European Space Operations Centre of ESA, responsible for the operations of the ESA satellites, has for some years recognized that staff knowledge is the fundamental pillar for maintaining and strengthening its position in the field of spacecraft operations.

ESOC has therefore established the strategic objective to implement an advanced Knowledge Management (KM) System that fosters initiatives, processes and procedures.

ESOC's knowledge base and its corresponding abilities has grown considerably over the years by means of engineers who sometimes have spent decades working on the same project and learning from the senior members. Today, this institutional knowledge base may shrink for several reasons: (a) many of those individuals are retiring; (b) there is an increase in staff mobility; (c) new staff are immersed into new projects sometimes without a substantial introduction to the previous mission's lessons

learned.

The primary goal of KM in ESOC is therefore to identify, capture, share and reuse the existing knowledge so as to enhance operational efficiency, minimize operational risks and increase innovation by continually enriching ESOC's information, as shown in the diagram below.

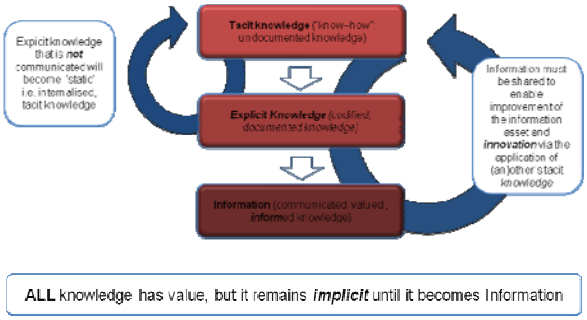

Fig. 1 The Knowledge/Information Continuum (Logica)

Within the previous work on KM [1,2,3,4], the foundation of the knowledge management system was laid and the following essential items were conducted:

- implementation of a knowledge management structure and organization,
- knowledge breakdown into domains, areas, fields and components,
- conduct the coverage and criticality analysis,
- building ICT supporting tools.

Based on the breakdown of the knowledge domains [4], the coverage and criticality analysis was performed and one of the specific actions that were taken was the investigation of knowledge capture methodologies especially for staff leaving the Agency, which is the topic of this paper. The reason that this was seen to be a high priority can be demonstrated by use of the Organisational Cognitive Spiral [11]:

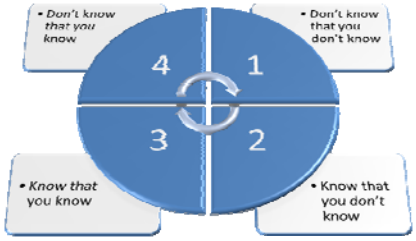

Fig. 2 The Organisational Cognitive Spiral [12]

As can be shown, leaving staff fall very much into quadrant 4 of the spiral i.e. "Don't know that you know", which can have a significant negative effect on the 'flow' of the knowledge/information continuum:

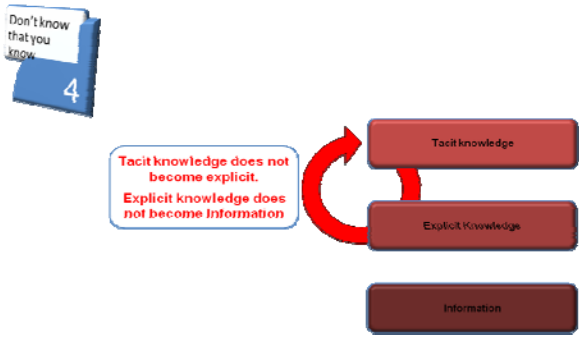

Fig. 3 The negative effect that people in quadrant 4 of the cognitive cycle can have on the flow of the knowledge/information continuum

Further, we can analyse in more detail the issues that can arise from people who are in this quadrant:

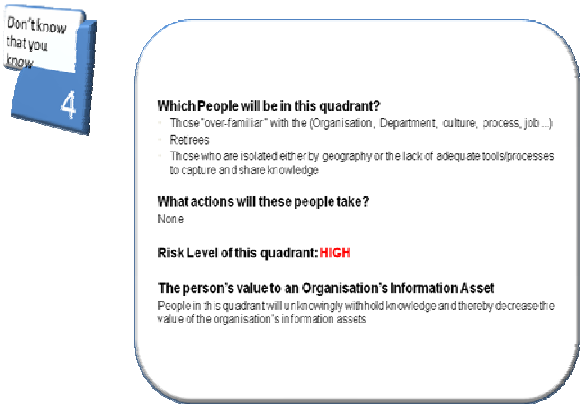

Fig. 4 High-level analysis of the issues that can arise from people within quadrant 4 of the cognitive cycle.

These issues can be addressed by a variety of both long-term and short-term initiatives:

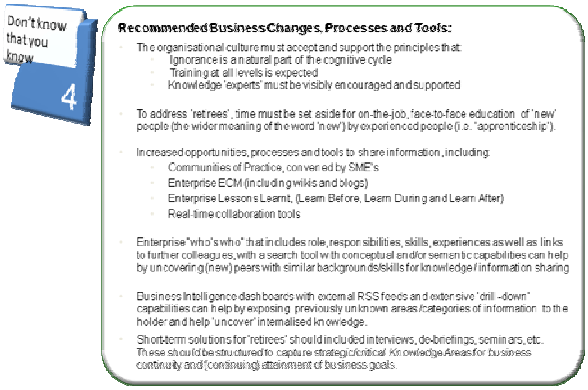

Fig. 5 Initiatives that address the issues of 'Quadrant 4'

Whilst most of the initiatives mentioned in figure 5 are either in place or planned at ESOC, in this paper we are focusing on the short-term objectives of Knowledge Capture.

It would be nice if one could compare the knowledge capture and transfer from one staff member to another with an office removal where one packs the documents into boxes, moves them to the new location and puts them into the new racks in a well defined order. Of course, the transfer of knowledge between staff cannot be compared with an office removal. The transfer of knowledge is extensive and complex.
A further point should be mentioned. Within an office removal things may be destroyed or get lost. This holds for knowledge transfer as well. Estimates say that about one third of the experience accumulated within the many years of service will not be transferred, it will be lost. As the transfer of knowledge between staff is extensive and complex, it has to be carried out as thoroughly as possible in order to minimise this potential loss

2. KNOWLEDGE TYPES

The split of knowledge into explicit and tacit (sometimes called implicit) components is quoted very often. Explicit knowledge is 'codified' knowledge kept in the form of documents, user manuals, videos etc. Tacit knowledge refers to skills and experiences. Whereas the element 'know' (information) refers primarily to explicit knowledge, the element 'be able' (qualification) is linked to tacit knowledge which has been acquired through years of practice. Very often tacit knowledge forms the bigger part of the entire knowledge basis maintained within an organisation. Investigations have shown that the knowledge basis of an organisation could consist of up to 80% of tacit knowledge and hence only 20% of knowledge could be retrieved from explicit knowledge in the form of documents etc. Effectively: the majority of the knowledge base may be maintained in the heads of the employees.

As tacit knowledge seems to form the larger component it is worthwhile to discuss it in more detail. Tacit knowledge is based on experience which is gained through the execution of activities and subsequent critical review. The repetitive execution of activities leads to improved knowledge and understanding. In this context, experience is procedural knowledge (i.e. to 'be able'). In particular, experience helps the grasp of situations; it derives associations, recalls action patterns, judges feasible solutions and takes decisions. Furthermore experience is very individual, and evolves with time; it can only be captured to a limited degree. In essence then, tacit knowledge is not only the bigger part but it is also the more difficult part to capture.

For completeness it should be added that other ways of defining knowledge 'types' are quoted in the literature, for example in the following groups [5]:

- explicit, conceptual knowledge is also called declarative knowledge
- implicit, action knowledge, is also called procedural knowledge
- intuitive, vision knowledge, is also called figurative knowledge.

Some references [6] put more emphasis on knowledge by experience. It is not only tacit knowledge, but it is unique and personal as it is based on many individual occurrences of both good and bad experiences. Knowledge by experience is the sum and the result of autodidactic processes and hence it is to some extent a mixture of declarative, procedural and figurative knowledge.

However, ESOC's knowledge capture procedure takes into account the classical split into explicit and tacit where the latter will be split into specialized knowledge and knowledge by experience (sometimes called empirical knowledge).

3. KNOWLEDGE CAPTURE

The term 'Knowledge Capture' is normally used for two types of processes. On one hand there is continuous knowledge capture and transfer during the course of a project, (refer Figure 5) where methods like communities of practice, mentoring, master-student (sempai-kohai), project tandems, lessons learnt or documentation standards are used. On the other hand there is knowledge capture and transfer at specific points in time when staff members are leaving their posts due to change of position within the organisation, leaving the organisation or retirement. In these cases knowledge capture describes the methods for catching key/critical knowledge by helping these people to articulate and make explicit their knowledge for later sharing. For this latter capturing process three methods are generally quoted:

- coverage analysis to identify where unique knowledge exists;
- structured interviews following an interview manual;
- extended overlap in case of staff departure.

Solutions for avoiding knowledge losses upon the departure of employees can be anticipated. Knowledge sharing is an essential sign of a knowledge-based enterprise. Organised exchange of views, tandem-concepts, mentoring systems, documentation and archiving of project knowledge and knowledge of experiences in information systems are examples of successful knowledge management processes which would ease the situation at change-over of employees. Of course, generous hand-over periods would help as well.

Although various methods for knowledge capture are listed it can be seen that this process requires primarily verbal communication. The transfer of experience in a verbal form should be preferred compared to the written one. Verbal communication creates contact and nearness which are essential for the passing on of experience. Experiences are best exchanged in the personal conversation.

Generally knowledge transfer is described by considering the two types of knowledge: tacit and explicit. The resulting four quadrants are [7]: socialization, externalization, internalization and combination, as shown in the Fig.6.

For each of these four quadrants various means for knowledge transfer could be used. However, for our capture needs only the first two are of interest and are listed below:

Socialization: communities of practice, coaching, job-rotation, mentor-system, discussion-fora, partnership, trainee programs.

Externalisation: k-maps, story-telling, mind mapping, chat-rooms, idea-management, interviews.

Knowledge Transfer	to Tacit	to Explicit
from Tacit	**Socialization** Exchange of experienced conceptual knowledge	**Externalization** Knowledge codification, documentation
from Explicit	**Internalization** Operationalize on an systematic knowledge	**Combination** Individual basis to assemble available knowledge

Fig. 6 – Knowledge transfer types

An overview on the degree of structure of experience transfer within an organization is given in Fig.7 below.

Verbal Means	Individual Communication	Professional Collaboration	Initiation of experience transfer through the company	as before plus story-telling training
Written means	Voluntary hints or brief reports	Standardized Lessons-Learned Reports	Documentation Professional story-telling	
----------→ Degree of Structure				

Fig. 7 – Knowledge transfer degree of structure

4. OVERVIEW OF KNOWLEDGE CAPTURE METHODS

Knowledge capture is required at different stages/ levels such as within projects or when staff leave their post, either by changing their position within the organization, or by retirement. The procedure for knowledge capture has to be well structured in order to make sure that the broad spectrum of the knowledge of the leaving staff is systematically scanned. All relevant subjects have to be covered in a systematic approach and not by pure chance.

A willingness to cooperate by all participating members is a prerequisite for the successful conduct of this knowledge capture procedure.

The procedure for knowledge capture for leaving staff is based primarily on the following approaches:

a) Rosetta Knowledge Management Video Approach

Rosetta is a long duration mission, with seven years of pre-launch development, a launch in 2004 and twelve years of post-launch operations. In order to maintain the expertise for both the operations and the engineering a Rosetta Knowledge System (ROKSY) was developed during the years 2002/3. ROKSY is now located at ESOC and it is maintained throughout the mission duration. The following ROKSY documents were taken into account for the KM Capture work:

- Interview Guidelines, TN-008 (more general aspects on interview techniques)
- Editor's Script, TN-001 (basic guidelines for the preparation of the interviews for all instruments)

- GIADA Interview Script, TN-010 (detailed planning for the interviews with the GIADA instrument team)
- Indexing Handbook, TN-007 (proposed way for the index files for the interview videos)

b) Siemens AG [8]

The company Siemens AG has introduced (in cooperation with some other enterprises) a Leaving Expert Debriefing Process in order to reduce the loss in knowledge and experience when staff are leaving their posts. The debriefing is a kind of workshop with a duration of about 0.5 days. The leaving expert describes his duties and their dependencies with emphasis on the methods applied, the information flow, the contact persons and the outstanding actions. He explains from his point of view the required specialized and organizational know-how. He also outlines what he would do differently with the knowledge of today. The participants of this workshop are the members of his group. The chair of the debriefing would be the superior.

c) The Take-over between Generations [9]

This publication describes the activities prior to the actual knowledge capture interview, i.e.

- inquiry about the leaving staff with respect to the post and its related activities
- questions to the superior and colleagues about the function and the role of the leaving staff
- evaluation of the two inquiries.

e) Credit Suisse [10]

The three phases for the knowledge capture process as applied at Credit Suisse are:

- Identification;
- Transfer methods: non moderated methods for simple cases, moderated methods for the more complex cases (Story-telling, SWOT (Strengths, Weaknesses, Opportunities and Threats)-visualization, Best v Worst Practices, Case-based Walkthroughs).
- Transfer/ Communication.

The knowledge capture process has advantages, of which in fact all participants would benefit:

- Advantages from the point of the enterprise: Preservation of the knowledge of experience; no inefficient or unnecessarily long hand-over periods; efficient transfer of projects; transparency in functions and processes; recognition of improvement possibilities, closure of gaps between vision and actual work.
- Advantages for the successor: efficient and shorter hand-over; fast increase of decisive competence; maintaining the personal network of the predecessor,
- Advantage for the staff leaving: working report refers to actual projects, skills and abilities; esteem and motivation by interest in the performed work; support of the career planning by more transparency in fields of knowledge and functions.

Whereas the reference ***b)*** proposes a kind of workshop (called expert debriefing), the other ones recommend interviews (moderated or un-moderated). For completeness some further explanations are added for the comparison of both methods:

The expert debriefing is a kind of forum/ workshop in order to allow the expert to explain his specialized knowledge for a selected range of topics to a larger group of participants. Of course, the assistance of a moderator would help to facilitate to express the underlying expertise. In essence, the goal of the expert debriefing is twofold, the expression of the underlying expertise in a verbal interaction with the audience and the recognition of the expert's merits.

The interviews would be applied for the description of complex subjects. Obviously they have to be video-recorded. The participation of the interviews would be very limited, i.e. the expert, the moderator and the IT member.

It has to be added, that there is no basic difference for the overall structure of the procedure with respect to the preparation and its conduct

Knowledge capture within running projects could be achieved with the help of Lessons Learned procedures. Enhanced Lessons Learned Workshops should be conducted at certain milestones during the project ('Learn During') but as a minimum towards the end of the project ('Learn After'). There are different examples in the literature, where structures, questions and topics are listed which should be considered in the lessons learnt workshops. Another example introduces structured interviews with the help of a moderator. This methodology is very similar to the one for leaving staff members. In fact, at the end of a project most of the members are leaving their posts in order to take up new duties. Hence there is a significant similarity between knowledge capture for departing staff members and for running projects.

5. DESCRIPTION OF KNOWLEDGE CAPTURE COURSE

The references listed in the previous chapter quoted the following three steps:

- Identification of knowledge subjects
- Transfer of knowledge
- Documentation.

An additional step dedicated to the preparation of the interviews could be inserted between steps 1 and 2, resulting in a 4-step process as shown below. A detailed description of this knowledge capture procedure is provided in the next chapter.

Step 1: Review of knowledge coverage/criticality status via an inquiry. The objective is to assess the important knowledge subjects of the leaving staff as well as the knowledge demand required by the group and the successor. For the identification of the essential knowledge items to be captured different viewpoints should be adopted in addition to the chronological review of the projects supported. The quality aspects could be other viewpoints such as best and worst practices, contribution of success factors and mistakes that could lead to a possible failure.

Step 2: Plan for debriefing and interview. This includes the sequence of knowledge subjects for the debriefing / interviews and its structure.

Step 3: Conduct of Debriefing / Interviews with the goal to capture tacit knowledge and to facilitate its documentation. The various viewpoints mentioned in step 1 (above) have to be adopted for the conduct of the expert debriefing as well as for the interviews.

Step4: Documentation of tacit knowledge. All information/knowledge derived from the debriefing / interview should be documented using as many different media and diverse presentation tools as possible in order to increase the effectiveness of communication. For example written transcripts of video/audio should be provided as well as 'meaning-based', semantic or conceptual searches that search video content.

The references related to the Expert Debriefing consider this option as mandatory for leaving experts, not only to provide the expertise to a larger audience but also as a sign of appreciation of the achievements of the leaving expert. The status as expert will be emphasized through this method.

The selection of the interview option (with or without moderator, with or without video recording, Fig. 8) clearly depends on the complexity of the subject to be handled as well as the usefulness of the moderation and the recording. Some further explanations are given for these three items, i.e. moderation, recording and complexity.

	without moderator	with moderator
With video recording & tagging		High complexity
Without video recording & tagging	Low complexity	

Fig. 8 - Interviews as function of level of complexity

Moderated methods for knowledge capture are useful for complex subjects of knowledge and expertise. It can be assumed that the leaving expert has a magnitude of knowledge, ideas, perceptions and expertise which he is not always aware of. Hence a good guidance through the discussion and explanations facilitate a deeper assessment/ examination/ review of the subject and can bring to light tacit/implicit knowledge. There are various methods available for the knowledge transfer from implicit to explicit (Story-telling, SWOT-visualization, Best and Worst Practices, Case-based Walkthroughs) and the skill of the moderator lies in the selection of the most appropriate method for the given situation.
Non-moderated methods are useful for less complex knowledge subjects as user knowledge of applications.

Video-recording could be used for the documentation of the interviews. Audio-visual means are a very valuable complement within the preservation methods which could be re-played in the future when the need arises.

The level of the complexity of the subject could be derived from the criticality and coverage figures collected within the Appraisal. The criticality figure is based on the role, the speed of change and the market availability. Obviously, the lower the criticality figure is, the less important becomes the interview subject. A similar relation holds for the coverage figure. The higher the number of available experts, the less important the interview subject becomes.

6. CAPTURE PROCESS MODEL

As mentioned in Chapter 4 two approaches could be envisaged, i.e. expert debriefing or interviews.
From a procedural point of view there is no basic difference between them as step 3 would be either the debriefing or a sequence of interviews whilst the other steps would remain identical for both approaches. It is noteworthy to mention that in some cases it may be useful to apply both approaches having first an expert debriefing open to a larger audience followed by a more focused interview restricted to a few individuals.

Step 1: Review of Status, Inquiry

Objective:

- Assessment of the important knowledge subjects of the leaving staff as well as the knowledge demand required by the group and the successor

Input:

- Coverage and criticality analysis

Responsibility: Superior

The questions and the addressees listed below have been extracted to some extent from the publication of Paul Kral [9]. Obviously, not all of them need to be raised within every knowledge capture process. A subset will have to be compiled on a case-by-case basis. However, they are listed here in order to emphasize the necessity to adopt various viewpoints for the identification of the essential knowledge subjects. In addition to these questions a review of the relevant part of the appraisal (coverage and criticality analysis) would have to be done with the leaving staff member and the superior.

Content of preparatory discussions and/or questionnaires:

a) Questions to the departing employee (status of documentation, critical issues, self-assessment with respect to competence and experience):

- Which of your own activities steer your daily business?
- How do you see your own role with respect to projects, innovation and problem solutions?
- With which measures do you master difficult situations?
- Which activities, roles and functions will become vacant?
- How do you describe your knowledge and how does your competence become visible?
- Which experiences and which knowledge are especially valid in view of successful-critical processes and results?
- How have longer absences (illnesses, vacation) affected the day-to-day work up to now?
- Which knowledge was particularly missed and in which areas?
- Which knowledge is documented?

b) Questions to the superiors, colleagues and employees

- Which knowledge and abilities are connected with the departing employee?
- Which knowledge was vital for the success of the company, the department?
- Which core competences make the difference to the knowledge of the other employees?
- What have they learnt, copied or taken over from the departing employee?
- What is this person able to do that others cannot?
- What could happen in the company/ department after his departure within one month, a quarter a year or 5 years?

c) Questions to the successor (if already nominated):

- What is the knowledge demand with respect to the departing staff?

d) evaluation of the three inquiries:
Based on these initial discussions the following classification should be possible:

Knowledge Domain/ Area/ Field	Explicit knowledge (Documents etc)	Tacit knowledge (Specialized)	Tacit knowledge (Experience)
a			
b			
c			

Figure 9 – Interview preparation (stage 1)

For each knowledge domain/area/field the current situation with respect to the three categories (explicit, specialized and knowledge by experience) could be described in brief words indicating critical issues and priorities. A result of this exercise should be a list of priorities for:

- The 'generic' questions to be asked around each knowledge domain/area/field (though it must be noted that the questions ***at this stage*** may only be

at the 'domain' level, due to lack of available detail). These questions will be based on the understanding of 'what is missing' i.e. tacit knowledge for both specialised and experiential areas

- What knowledge/information is currently available, and where it resides.

Figure 10. Interview Preparation (stage 2)
The ESOC Knowledge/InformationTaxonomic Model

At this point this information is plotted on the Logica Taxonomic model in order to help generate the actual questions to be asked at the debriefing/interview. The taxonomic model is a type of Entity Relationship Diagram (ERD) that provides a way of focusing on the five main perspectives that are common to both information and knowledge:

- **What** (Asset: capital operational, intellectual, process...)
- **Where** (Location: physical, virtual, electronic...)
- **Who** (Participant: person, group, role, project...)
- **How** (Activity: data by mission, construction project, launch, operational satellite...)
- **When** (Grouping by time, classification, territory...)

The model can document ESOC's information to any level of granularity, thus illustrating and promoting further questions about 'Parent/Child/Sibling' relationships relative to ESOC's information asset and the related tacit knowledge field that is in focus. In addition the taxonomic model immediately suggests other questions around the tacit knowledge field based upon the Taxonomic Models structure of "What, Where Who How & When"

The results of this second stage of interview preparation are questions that incorporate both the high-level conceptual viewpoints suggested by Paul Kral [6] together with ESOC's existing information/knowledge base.

Step 2: Debriefing / Interview Plan
Objective:

- Sequence of knowledge subjects for the debriefing / interviews (sequence, complexity), structuring of subjects

Input:

- Results of review and inquiry, list of essential knowledge subjects to be covered, plotted against the Logica Taxonomic model

Responsibility: Superior

The starting point for the debriefing / interviews will be a combination of the coverage analysis, the distribution of expertise and the list of essential knowledge subjects to be covered. These have to be prioritised from the perspective of complexity.

a) Questions related to sequence and complexity of subjects:

- which knowledge can only be transferred face-to-face?
- which knowledge could be acquired through 'learning by doing'?
- which knowledge is required immediately and which later on?

b) Structure of the debriefing / interviews with respect to the individual subject:

A prioritised table can then be produced indicating a few parameters, such as

- type (moderated, non-moderated)
- tools required (presentations, video, etc)
- participants
- emphasis on topic drawn from the taxonomic model
- planned time for de-brief/interview
- remarks

Step 3: Conduct of Debriefing / Interviews

Objective:

- Facilitate the transfer of tacit knowledge and its documentation

Input:

- Debriefing / Interview plan (sequence, complexity, structure)

Responsibility: Superior plus moderator, ICT staff

Based on the priority list established above the tacit knowledge can be discussed, described and explained using actual problem cases as a basis. Supporting questions would be:

- in which projects/ processes applied, internal workflows, norms and rules, contact persons
- which problems arose, how were they solved (methods and rules of thumb)
- lessons learnt, best practices, worst practices, what would you do differently today and why.
- other questions as suggested by relationships shown by the Taxonomic model (Parent/Child/Sibling relationships to the tacit knowledge area, plus 'Who, What, When, Where, How' relative to ESOC's current information'map'

Step 4: Documentation

Objective:

- Documentation of tacit knowledge

Input:

- Debriefing / Interview results

Responsibility: Superior plus moderator, ICT staff

Depending on the complexity of the topic the documentation could be achieved by simple minutes in text form, power point presentations, videos, etc. However the results of the debriefings/interview should be recorded using as many different format types as possible in order to explore every possible avenue for effective communication. The documentation can also be plotted against the ESOC Taxonomic model to highlight where additional knowledge may still be required.

7. BARRIERS AND POSSIBLE REMEDIES

Even the best procedures for knowledge capture will not work efficiently when barriers have not been removed. Typical barriers with respect to knowledge capture are lack of time, high performance standards combined with competition in various forms. In general these barriers can be split into extrinsic and intrinsic ones. Within this chapter only the extrinsic barriers are considered whereas the intrinsic ones dealing with motivational issues are not discussed.

a) Lack of Time

Very often time pressure is so high that even the performance of the day-to-day activities could suffer. In such cases time allocation for work connected to knowledge capture will not be sufficient. The transfer and documentation of knowledge and experience will either not be done at all or only at a superficial level without necessary detail.

Especially for 'Learning Organizations' the provision of adequate time is essential as learning, improvements and innovations can only be achieved when adequate time is made available.

b) Very high Performance Standards

In an environment where the terms 'high efficiency' and 'risk free' belong to the utmost goals of the organization, staff might tend to hold back problems and errors or at least to search for justifications outside their own area of responsibility. Certainly, admitting failures is not a basic attitude of people. The entire avoidance of mistakes in our culture and in the enterprise becomes a problem. Setbacks, wrong tracks or obstacles can enrich our knowledge and experience. The goal to work by all means without mistakes hinders the ability for innovation.

Mistakes are normally not made on purpose, they simply may happen. Mistakes should be taken as a chance for a new assessment of the situation. A change in culture from 'error-free' to 'learning' would be required. Mutual respect and appreciation of staff would support this behaviour.

c) Knowledge is Power

The view 'knowledge is power' could lead to fear of loss in power or authority and hence would lower the readiness for knowledge transfer. The more competition is promoted amongst employees, the less they would be ready to share their knowledge and their experience with others.

One recommendation would be to introduce additional incentives on the basis of preparedness for knowledge transfer next to the pure judgment of achievements.

d) Hidden-Profile-Phenomenon

This phenomenon illustrates a strong communication barrier. Members within the group may possess special knowledge which remains hidden to the others colleagues. Optimal decisions cannot be taken due to these restrictions.

A communication culture should be established which creates space and occasions for informal, personal talks as well as for specific exchanges of view. This culture should promote communications at different levels. It is said that the frequency of these events would be of less importance compared to the quality of the information and experience exchange. The introduction of an open communication culture generally has to be led from the top.

8. OUTLOOK

This paper has presented the current work at ESOC related to tacit knowledge capture. This is in the context of the Knowledge Management Initiative carried out in the Directorate.
Currently knowledge capture processes as described in the paper are applied to expert leaving staff, but it is the ultimate goal to develop a standard repeatable procedure.

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